The gender lifetime earnings gap—exploring gendered pay from the life course perspective

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Research on the gender earnings divide so far mostly focuses on the gender gap in hourly wages, which due to its snapshot nature is unable to capture the biographical dimension of gendered pay. With the 'gender lifetime earnings gap' (GLEG), we introduce a new measure that fills this gap. Based on a group of 72,085 German individuals born 1950-64 from the 'Sample of Integrated Labor Market Biographies' (SIAB 7510), we find that at the end of the employment career, women accumulate 46.6% less earnings than men. Thus, the GLEG is more than twice as high as the current German gender pay gap. The GLEG is higher at the bottom than at the top of the earnings distribution. It most prominently widens during the period of family formation (age 25-35). Relatedly, gender differences in endowments, mainly in terms of experience and hours, account for almost two-thirds of the GLEG. For younger cohorts, family breaks tend to lose importance, whereas the role of work hours remains unchanged. Moreover, women in younger cohorts approach men with respect to employment, education and sector premiums.

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Introduction

During the past decades, increasing education and labor force participation rates of women have boosted female earnings and have led to a convergence of genders' employment patterns and earnings (O'Neill & Polachek 1993, Blau & Kahn forthcoming). Still, the available household income and the presence of a partner and children significantly impact women's employment patterns (Lauber et al. 2014; Boll 2011a, b; Anxo et al. 2007; Geyer & Steiner 2007; Jaumotte 2003; Hersch & Stratton 1994; Bielby & Bielby 1989). Time devoted to paid and unpaid work is subject to the intra-couple bargaining processes of partners (Beblo & Boll 2014). Even though men's engagement in childcare has significantly increased in recent decades (Boll et al. 2014), women still bear the lions' share of childcare in many countries (Boll et al. 2012), and so they do in Germany (Boll 2017, DIW 2016). Due to family-related employment breaks and part-time work, German women suffer severe earnings losses over their career, as a rich empirical literature with German data shows (Helberger 1984, Galler 1991, Beblo & Wolf 2002, Kunze & Ejrnaes 2009, Boll 2011a; b). With the standard gender pay gap focusing on the employed only, these aspects fall below the (statistical) radar.

One attempt to incorporate the gender employment gap in the calculation of the gender earnings gap has been made by the Organization for Economic Cooperation and Development (OECD), which reports a gender gap in annual labor market income per capita of the male and female workforce aged 18 to 64 years. This measure is based on various national micro data sets, including income from dependent work and self-employment. The percentage gender difference refers to men's income. In 2014, the gap stood at 39.0% as an OECD average (OECD 2017, Figure 1.6, Panel A) and at 45.4% for Germany. That is, women's per capita earnings in the respective age group were 45.4% lower than men's (OECD 2017). In the case that the gap refers to full-timers only, it amounts to 17.3%. This demonstrates the high importance of women's higher involvement in part-time work for the gender earnings divide in Germany. However, as a snapshot that focuses on a distinct point in time, this measure treats women who have never worked the same as women who are temporarily quitting the labor market.

A possibility to quantify the impact of women's labor market intermittencies and part-time work on the gender pay differential is to control for biographical (and other) "endowments" in individual wage regressions and to quantify their contribution to the gender gap in mean hourly wages via decomposition techniques. In a previous study with German Socio Economic Panel data (see Wagner et al. 2008), using this standard measure of pay inequality by gender, we found that gender differences in employment experience, occupational position and hours account for 5.6, 3.4 and 3.8 percentage points of the German gender pay gap, respectively (Boll & Leppin 2015). These results confirm the biographical dimension of gen-

dered pay (Boll 2015). However, due to the snapshot nature of the underlying decompositions, this measure is also inappropriate to monitor the evolution of the gender earnings gap over the life course.

To gain more insight into the biographical dimension of gendered earnings, it is necessary to focus on the earnings stream of single cohorts over the life course and their aggregate, lifetime earnings. To quantify the wage penalties of specific deviations from a full-time-full-year (FTFY) work pattern, it is necessary to take stock of individuals' accumulated earnings over their careers and link them to the associated biographical patterns.

Lifetime earnings are an important object of economic analysis since they are closely related to individuals' lifetime resources and welfare. As in the German Pension Insurance System, old-age pension entitlements essentially hinge on the individual's preceding employment career, so women who are only loosely attached to the labor market in terms of years in employment and/or working hours face an increased risk of poverty in old age. Women's lower earnings per hour (compared to men) further contribute to a gender gap in own old-age pensions. Because pensions constitute a major part of old-age resources, in 2014, 18.4% of German women and 14.0% of German men aged 65 or older were at risk of old age poverty (that is, their equalized disposable income was below 60% of the national median value; Eurostat 2016a). According to the Eurostat 2020 indicator addressing poverty and social exclusion, 19.7% of German women aged 65 or older were subject to poverty or material deprivation in 2014, compared to only 14.9% of men (Eurostat 2016b). Compared to a continuously full-time employed mother with two children, a mother who withdraws the labor market for five years between age 30 and age 40 achieves only 89% of gross pension entitlements compared to a mother with similar biography and family background but a continuous full-time career (estimates from OECD pension models, cf. OECD 2015, Fig. 3.13).

However, few studies so far have focused on lifetime earnings to explain gendered pay inequality. Bönke et al. (2015) use a lifetime earnings approach to explore intragenerational inequality in lifetime earnings. Based on German social security records, their analyses show that West German male cohorts born in the early 1960s are likely to experience about 85% more lifetime earnings inequality than their fathers' generations did. However, this analysis mainly focuses on men's earnings.

To our knowledge, ours is the first study to present lifetime earnings for women and men based on individual employment histories that cover 30 years at minimum and, on that basis, to calculate and decompose a gender gap in aggregate lifetime earnings. With the 'gender lifetime earnings gap' (GLEG), we introduce a new measure of gender earnings inequality that focuses on the life course perspective. With respect to the magnitude of the gap, we distinguish between the overall mean and 5% quantiles over the earnings distribution. Regarding the mean gap, we

analyse its magnitude and decomposition for distinct age groups. To this end, we use the information from 72,085 German individuals of the Sample of Integrated Labor Market Biographies ("Stichprobe der Integrierten Arbeitsmarktbiografien, SIAB 7510") for the years 1975-2010 for the cohort groups 1950-64. Furthermore, we exploit information from younger cohort groups on their accumulated earnings during early career stages to capture changing patterns across generations.

We expect, first, that the role of women's years of non-employment and part-time employment will play a far greater role for the GLEG than for the gender pay gap in hourly wages, which refers to average wages of old and young women and men with or without children. Second, we assume the gender wedge in accumulated earnings will be lower at age 25 than at age 35 and this one will be lower than that of age 55. This expectation is motivated by the literature showing that whereas the family context does not significantly depress men's employment and wages throughout their careers, it notably does for women. Third, we suggest that gender gaps in accumulated earnings at a given age are lower for younger cohorts than for older ones. Since the concept of the GLEG refers to the biographical instead of the calendar perspective, we are able to disentangle age from cohort composition. Fourth, we expect the measured gender gap in lifetime earnings will resemble the gender pension gap in magnitude. This is because pension entitlements in Germany closely relate to an individual's preceding labor market involvement in terms of years and hours. From this point of view, the GLEG provides some sort of sensitivity measure for the gender pension gap of the respective age cohort under investigation.

Relating gendered earnings to gendered biographical pathways relies on the notion that wages depend on individuals' labor market involvement and not the other way round. Therefore, we discuss the issue of reverse causality before we start with our empirical analyses.

Principally, reverse causality can be an issue. If some covariates contemporarily correlate with the error term of the earnings equation, an ordinary least square regression would lead to inconsistent estimates of the corresponding parameters. For example, individuals with lower earnings could choose lower labor market involvement in terms of longer absences (employment breaks) or/and fewer weekly hours (part-time work). Due to lower opportunity costs of leaving the workforce, women could also be more likely to become mothers (Lundberg & Rose 2000). However, this would only be the case if the substitution effect outweighs the income effect. Alternatively, lower wage rates might induce mothers to work even more (Mincer & Polachek 1974: 96). Likewise, higher wage rates may increase the probability of having a child if children are considered normal goods (Boll et al. 2013, Ariza & Ugidos 2007). As a consequence, women could temporarily leave the labor market. To sum up, the direction of causality is not clear a priori.

Theoretically, it would be preferable to use instruments that are highly corre-

lated to mothers' employment patterns but unlikely to be correlated with women's wages. In this regard, the literature on motherhood penalty uses indicators referring to the mother's socialization and parental background (Neumark & Korenman 1994; Joshi et al. 1999). However, the data at hand that strongly focus on wage reporting purposes of employers towards the German social insurance agencies do not provide any information in this regard.[1] Ultimately, the question of reverse causality seems to be an empirical one. The empirical evidence rather points to causality (cf. Blau and Kahn 2016 in more detail for some of the following arguments). First, one could think of the quite elastic response of women's labor supply to marginal income taxes as an argument in favor of reverse causality. The German "Ehegattensplitting" that imposes a high marginal tax on second earners in the household has been proven to reduce women's weekly working hours (Bach et al. 2011). However, the incentive operates via the net wage in this case. Hence, we cannot assess a potential impact of gross wages on labor supply of second earners without controlling the household context. Furthermore, between 1980 and 2000, females' own wage and income elasticities declined substantially in magnitude (Blau and Kahn 2007). Blau and Kahn (2016) interpret this finding as an indicator that paid work is playing an increasingly important role for women who are approaching men in this aspect.

Second, the thesis of wage-elastic labor supply hinges on the substitutability of intra-family childcare by market-based services, which itself depends on societal legitimacy, availability and cost. Societal norms, attitudes and role models as well as the availability and cost of institutional childcare proved to be of central influence. Behavioral options of women have increased across generations via gender mainstreaming processes and, relatedly, an increase in public childcare facilities. However, women nowadays still bear the lion's share on household and childcare tasks in most countries. They do so in Germany, and this holds even more for older cohorts that we deal with in our study. As societal norms and role models shape adolescents' occupational and work orientations, causality seems to run from rather low human capital investments at young ages to (resulting) lower earnings after labor market entry. As Blau and Kahn (2016) point out, under a traditional division of labor by gender in the family, women might foresee shorter and more discontinuous work lives as consequences of their family responsibilities; they will thus have lower incentives to invest in on-the-job training than men. This thesis strongly relates to Polachek's thesis of occupational choice, which also relies on human capital investment rationales in the context of gender roles (Polachek 1981). Comparatively lower earnings are hence the result rather than the starting point of women's labor market plans, which manifest during family formation in work interruptions and fewer hours. As a reinforcing process, both factors will further lower female earnings.

Third, the so-called 'motherhood penalty' gives some further indication of

causality. Being a mother could send a signal of lower productivity and commitment to employers (Spence 1973) that might depress women's wages by statistical discrimination. Mothers could be in fact less energetic and productive at work since they have to invest the greater part of their effort at home (Becker 1985). Blau and Kahn (2016) present some evidence on the named theories, e.g., the study of Hersch and Stratton (1997 and 2002). They found that additional hours spent in housework are, all else being equal, associated with lower wages.

The low de facto-substitutability of household work by market work for women born 1950-64 has been demonstrated by the "AVID Study" that investigates the employment behavior of West and East German cohorts 1942-1961 between age 15 and age 65 (BMFSFJ 2011a; b). The majority of women withdrew from the labor market in the course of childcare and elderly care. West German women, including those without children, exhibit an average duration of family-related non-employment spells of 7.9 years (cohorts 1957-1961) and 9.2 years (cohorts 1952-1956; BMFSFJ 2011b, p. 3). Only 16% (cohort 1952-1956) and 13% (cohort 1957-1961) had zero years of childcare-related employment (ibid.: 5). In addition, women regularly exhibited further non-employment spells, e.g., to assume household tasks. For example, childless women spent 14.5 years, while mothers of three children spent 10.3 years in non-family-related non-employment spells on average (cohorts 1942-1961; ibid.: 47). Eldercare-related breaks have been less widespread than childcare-related ones. From the life course perspective, childbirth occurs earlier than eldercare; hence, following the argument of endogenous work patterns responding to market wages, breaks should be less frequent in younger years when wages are high and more frequent in later career stages, but the AVID study reveals that the opposite is true. Moreover, the argument of dominant work routines and attitudes gains further support from the East-West comparison. East German women's average duration out of the market has been lower than that of their West German counterparts of the same cohort. Relatedly, East German women were less (more) likely to re-enter the labor market in a part-time (full-time) job, whereas the opposite holds for West German women (BMFSFJ 2011a, p. 13f.). To date, East German women's work patterns and work attitudes differ from that of West German women, both with regard to interruptions and working hours for historical reasons.

To sum up, although the data at hand do not allow us to deal with the issue of reverse causality empirically, we argue that in case of female employment, the empirical evidence rather supports the notion of causality when it comes to wages. This might be why since the seminal work of Mincer and Polachek (1974), gender differences in experience and labour force attachment have been seen as central to the understanding of the gender wage gap.

We find that at the end of the employment path, the GLEG of people born between 1950 and 1964 is more than twice as high as the current German gender pay

gap (21%), assigning women 46.6% less aggregate earnings than men. Numbers are remarkably similar to cohort-specific gender pension gaps (Grabka et al. 2017). From a biographical perspective, the gap most prominently widens during the period of family formation from age 25 to age 35. Relatedly, almost two-thirds of the overall gap refer to different endowments of women and men in earnings-relevant characteristics, mainly with respect to experience and hours. Whereas endowments work to the advantage of women at the beginning of their careers, the picture reverses during family formation. On the contrary, the unexplained gap is to women's disadvantage throughout their careers. In the cohort comparison, our results point to a slightly decreasing importance of family breaks for the gender earnings divide in younger generations, whereas the role of work hours remains unchanged. Moreover, women in younger cohorts approach men with respect to employment, education and sector premiums, which indicates decreasing wage mobility differentials between genders.

The outline of the paper is as follows. Section 2 presents the methodology, and Section 3 presents the data, variables and descriptive statistics. Section 4 discusses the results, and the conclusion in Section 5 completes the paper with a summary of core results and open questions for future research.

Methodology

The calculation of the gender lifetime earnings gap (GLEG) is closely related to the conventional gender pay gap analysis as applied by the German Federal Statistical Office. Both concepts are based on cross-sectional data, disregarding the unobserved heterogeneity of individuals. Wage analyses rely on gross earnings that are deemed to reflect human capital returns. According to the GLEG concept, lifetime earnings are defined as the sum of deflated daily earnings without interest over at least 30 years of the individual's employment biography, referring to the time of the last observation[2]. Consequently, the GLEG is defined as the percentage share of the gender lifetime earnings differential on male earnings. Unless specified otherwise, the GLEG relates to the mean unadjusted gender earnings gap, analogous to the mean unadjusted gender wage gap.

The econometric design of this study follows the conventional steps in analyzing the gender pay gap. In a first step, we carry out OLS lifetime earnings regression based on the described cross-sectional data set. In a second step, we decompose the identified unadjusted pay gap in its single components. The Mincerian wage equation is specified as the following linear equation,

$$ln(LE) = \beta_0 + \sum_j \beta_j x_j, \tag{1}$$

with LE being the cumulated earnings of an individual, β_j being parameters

and x_j being explanatory variables. Table A1 in the Annex provides the full list of explanatory variables.

To calculate the GLEG, we refer to the methodology used by the German Federal Statistical Office (Federal Statistical Office 2006, p. 5) for the calculation of the gender pay gap. That is, the gender lifetime earnings gap is calculated as the deflated aggregate earnings differential between women and men, related to those of men,

$$GLEG_{\text{unadjusted}} = \frac{\overline{LE}_M - \overline{LE}_F}{\overline{LE}_M} \times 100, \tag{2}$$

where $\overline{LE}_M$ depicts the average lifetime earnings of men and $\overline{LE}_F$ those of women.

Furthermore, we calculate the gender gap at different quantiles of the earnings distribution (including the median). Supplementing the aggregate gap at the end of the career, we also calculate the mean GLEG at different ages to track its development over different stages of life. The age-specific gap relates to the percentage difference in aggregate earnings between genders at the respective age.

Equivalent to the adjusted gender pay gap, the adjusted GLEG refers to the remaining gap in lifetime earnings between women and men when individuals with similar observable characteristics are compared. By contrast, the part of the gap that has to be attributed to different endowments in earnings-relevant characteristics is referred to as the explained lifetime earnings gap or simply the endowment effect. The explained and unexplained parts sum up to the measured overall (unadjusted) gap.

Note also that this statistically explained part of the gap may include discriminatory practices as far as opportunities to work in jobs with these wage-relevant attributes differ between genders. Moreover, the adjusted earnings gap must not be equated with discrimination (Boll & Leppin 2015, Federal Statistical Office 2006, p. 10). The adjusted wage gap consists of the wage regression constants and the evaluation effects. The latter measure the part of the gap that can be attributed to different remunerations of women and men for the same characteristic. The constant as a 'blind spot' is comprised of the earnings differential that can neither be explained by gender differences in endowments nor by remunerations for these endowments. Although a link to discrimination is most intuitive here, one has to bear in mind that the unadjusted gap might be due to (gender differences in) pay-relevant unobserved variables.

To decompose the unadjusted gap in its explained and unexplained parts, we refer to the seminal work of Oaxaca (1973) and Blinder (1973). The decomposition requires that the underlying linear regression models are valid for each group. The sample residuals indicate that the proposed linear lifetime earnings equation is indeed a valid model for both females and males (see Section 3.1). We use nor-

malization (Yun 2005), which renders the decomposition results independent of the base category for categorical variables. The decomposition equation notifies as follows (cf. Federal Statistical Office 2006),

$$\overline{\ln(LE_M)} - \overline{\ln(LE_F)} = \left(\beta_0^M - \beta_0^F\right) + \sum_j \bar{x}_j^F \left(\beta_j^M - \beta_j^F\right) + \sum_j \beta_j^M \left(\bar{x}_j^M - \bar{x}_j^F\right), \quad (3)$$

where $\overline{\ln(LE_M)}$ and $\overline{\ln(LE_F)}$ depict average log lifetime earnings of men and women, respectively. The first two terms on the right-hand side of the equation refer to gender differences in remunerations. The first term captures the pure gender effect as the difference between the constant terms arising from the male and female wage regression. The second term depicts the sum of weighted gender differences in evaluations, for all further characteristics beyond gender, whereby women's endowments serve as weighting factors. The last term on the right-hand side refers to the aggregate endowment effect. It contains the gender differences in observable characteristics evaluated with men's rewards[3]. It depicts the hypothetical wage gain of women if they had men's characteristics.

Data

Sample

The basis of our analyses is the Sample of Integrated Labor Market Biographies ("Stichprobe der Integrierten Arbeitsmarktbiografien (SIAB) 1975-2010")[4]. The SIAB is a 2 percent random sample drawn from the Integrated Employment Biographies (IEB) of the Institute for Employment Research (IAB), comprised of employment careers of 1,594,466 individuals from 1975 to 2010. The information comes from various sources, the Employee History ("Beschäftigten-Historik–BeH") being the most relevant for our purposes. The information refers exclusively to employees who are subject to statutory welfare contributions. Because employers are required by law to report the exact beginning and end of any employment relationship that is subject to social security contributions, and because misreporting of earnings is punishable by law, the SIAB is a very reliable source of employment information in Germany (Nedelkoska et al. 2013).

The sample contains individuals of the cohorts 1950 to 1964 that are observed in the context of employment, the receipt of payments or employment search. Because the observation period of the data spans from 1975 to 2010, no one can be observed for longer than 35 years. Hence, a longer observation period comes at the cost of lower numbers of observation and vice versa. We restrict the sample to individuals with a career of 30 years at minimum. Since the AVID ("Altersvorsorge in Deutschland") study shows that cohorts 1942-1961 exhibit an average employment duration of 30.2 years for women and 39.8 years for men (BMFSFJ 2011a),

our standard perfectly meets women's careers while it is below the one of men. We exclude people participating in apprenticeships or training as well as those persons who were employed before the starting point of our data, 1 January 1975, to ensure that we observe careers from their very beginning. For labor market entry, we pose the following maximum ages (depending on a person's attained education), age 30 (people with tertiary education), age 24 (people with completed vocational training and high school graduation–Abitur), age 21 (people without Abitur and completed vocational training and for those with Abitur but without vocational training), and age 18 (persons lacking both of the latter named qualifications). When analyzing individual sample residuals at this stage of sample formation, the skewness values (see Table A 7 in the Annex) show that the share of overestimated lifetime income (=negative sample residuals) values was higher than it should be under the assumed model. This overestimation mostly occurred for individuals with a low number of years of employment and/or long times of "unobservability" during their career. This led us to impose two additional sample restriction criteria. First, we required that people are reported as employed for at least 5 years between their first and last appearance in the dataset. Second, individuals are not allowed to exhibit more than 20 years of 'blind spells' (times where they are not observable) during that period.

Note that these criteria concern the cohorts 1950-1964, which are the main focus of the paper. However, for consistency reasons, the respective criteria are adopted for the younger cohort groups in a similar way whenever these groups are analyzed. Individuals of the cohort group 1970-1979 are required to be employed for at least 1/6 of their minimum of 10 years between first and last observation and are required to have no more than 2/3 of 'blind spells' during this time period. The same holds for the cohort group 1980-1989, with the difference that individuals of this group are only required to have at least 5 years between their first and last observation.

With the new restrictions, individuals with low education and a low labor market attachment are over-proportionally excluded from the sample, and women are more affected by this restriction than men. We expect that this new more positively selected sample, particularly concerning women, affects magnitude and composition of the gender lifetime earnings gap. The overall gap should become smaller, and relatedly, educational gender gaps and gender differences in (non-) employment experience should decrease. Table A 8 in the Annex provides a full list of exclusion criteria and the respective observation losses.

After implementing these restrictions, we end up with a sample comprised of 72,085 individuals (cf. Section 3.3 for sample statistics). Due to the requirement of a 30-years-observation period, individuals who grew up in the eastern part of Germany were excluded. Thus, our sample is comprised for the most part of West Germans[5].

Variables

Regarding the covariates used in the wage regressions and wage decomposition analyses, we employ the standard individual and workplace-related variables that are used in gender pay gap analyses (cf. Boll & Leppin 2015, Federal Statistical Office 2006). Part of them are used in their original format (cf. vom Berge et al. 2013 for more details), while others were generated for the study-specific purposes. Because the dependent variable focuses on the life course, we specify all time-variant covariates by their duration in years. To this end, we use the employment status information given on a daily basis in the spell-formatted raw data and transform days into years.

Lifetime earnings are based on gross daily earnings, including fringe benefits. This information is provided in the BeH file of our data. The daily wage is calculated by the data provider from the fixed-period wages reported by the employer and the duration of the (un-split) original notification period in calendar days. The daily wage is shown in euros. Earnings exceeding the upper earnings limit for statutory pension insurance are only reported up to this limit. To correct the right censored earnings at this threshold, we use the imputation method introduced by Gartner (2005)[6]. More specifically, we predict (uncensored) earnings beyond the upper ceiling by using parameter results for age, occupation, sector and other characteristics from a Tobit earnings estimation based on a sample of individuals whose earnings are located below but close to the ceiling[7]. We specify the earnings equation as a Tobit model based on the assumption that earnings follow a logarithmic normal distribution. We aggregate daily earnings on a monthly and finally yearly basis. Annual earnings are further aggregated to age-specific total earnings (for the analysis of age-specific gender earnings gaps) and to lifetime earnings (for the analysis of the GLEG), respectively. As noted, lifetime earnings refer to the accumulated earnings of an individual at the time of his or her last observation in the data.

For individual characteristics, we use gender, year of birth, nationality, education, occupation, and employment status. Year of birth ranges from 1950 to 1964. Due to rather low numbers of individuals with foreign nationality in our sample, we generate a binary, time-constant variable that simply differentiates between individuals with German nationality throughout their (observed) career and other individuals (individuals with at least one observation of a non-German nationality). Regarding workplace-related information, we differentiate between 9 area types according to settlement structure, referring to the Federal Institute for Research on Building, Urban Affairs and Spatial Development for the year 2009 (BBSR 2011)[8]. The variable is constructed as the years of employment in the respective area types.

We further control for sector affiliation, occupation and the number of employers in the career. Sector affiliation depicts the employment experience in a specific

sector in years, referring to the German Classification of Economic Activities 1993 (completed by extrapolations and imputations). The SUF data provide us with 14 sectors (cf. vom Berge et al. 2013, p. 43).

The occupational information available in the data refers to the occupational title of the job performed, which can differ from the originally trained-for occupation. Occupations are classified according to the 'Klassifizierung der Berufe 1988' ('KldB 88'), consisting of 330 categories. To increase the sample size by occupations, we follow Matthes et al. (2008), who aggregated 3-digit-occupational groups based on the KldB 88 to 21 occupational segments ('Berufssegmente'; see Stops 2011, Annex Table 5, for the detailed assignment of groups to segments). The segments include vocationally similar occupations whereby similarity is empirically validated by occupational performance and recruitment alternatives drawn from the 'Zentrale Berufedatei' of the Federal Employment Agency (Matthes et al. 2008). Because we expect that similar occupations generate similar earnings, the employed notification of segments is very valuable for our occupation-specific earnings analyses from the life course perspective. As for area type and sector affiliation, the corresponding variables measure the employment experience in a certain occupation (segment).

Concerning formal education, we resort to the most robust information given in the BeH file. We distinguish between five levels: (1) no completed vocational training, vocational training (2) without high school degree (as reference) or (3) with high school degree, a degree from (4) university of applied sciences, or (5) a university. To address remaining missing and inconsistent information, we use the recoding and imputation scheme by Fitzenberger et al. (2006). Since employer changes often relate to a change in earnings (e.g., for displaced workers, see Nedelkoska et al. 2013), we control for the number of establishment changes in the individual biography. This information was drawn from changes in the establishment identification number.

Years of employment are crucial for our analysis. Therefore, we employ a fine-grained analysis of the individual employment biography. Regarding years of employment, we differentiate between (years of) part-time and full-time work and use the latter as a reference in our analyses. A person works part-time when his or her individual contractual work hours are below the usual weekly work hours in the firm (cf. vom Berge et al. 2013, p. 43). Note that usual work hours vary between firms. More precisely, we distinguish between small-scale part-time (1-17 weekly work hours) and large-scale part-time (18 hours or more but less than the firm-specific full-time work)[9]. Observations of part-time retirement that were derived from the occupational position variable are classified as low- or large-scale part-time work, depending on weekly hours.

Non-employment refers to either registered unemployment, (observed) out-of the labor force (OLF) spells, or unobserved employment breaks. Because the data

relate to employers' documentation for social security purposes, OLF spells refer to time spells during which the employment contract is maintained but the employee receives zero wages (e.g., sick leave paid by statutory health insurances).

'Blind spells' are periods in the individual career that lack any individual status information. They are far more frequent and of a longer average duration than OLF spells. Only 4.7% (6.7%) of women (men) show no 'blind spell' in their career. Roughly 35% (20%) of females' (males') 'blind spells' cover a full year. When the break is not preceded and succeeded by an employment spell, that is, the beginning and end of the break are not observed in the data, the person is excluded from the sample. 'Blind spells' may have multiple reasons, e.g., family-related breaks, spells of self-employment, or breaks related to further education and training. In general, we assume that during that time, no employment relationship is in place that is fully subject to social insurance (cf. Ejrnæs/Kunze 2006). We argue that human capital depreciates during any labor market absence, disregarding its specific motivation, as shown by rich empirical evidence based on German data that confirm notable earnings losses due to employment breaks (Beblo & Wolf 2002, Kunze & Ejrnæs 2004, Gangl & Ziefle 2009, Boll 2011a; b). Since women work part-time and interrupt their careers more often than men, a pattern that notably contributes to the German gender pay gap (Boll et al. 2015; Boll & Leppin 2015), focusing solely on OLF spells when measuring employment breaks would most likely underestimate the true dimension of female (and male) labor market withdrawal and the related earnings gaps.

Until 1 April 1999, employers in principle only reported the earnings that were subject to social security contributions. Earnings below the marginal part-time income threshold were not reported (cf. vom Berge et al. 2013, p. 41). For this reason, we do not exploit information on marginal employment in this study. For the sake of consistency, marginal employment information from 1 April 1999 onwards is recoded as 'blind spell' information, as was the case for the period before[10].

The gendered pattern of vertical segregation is relevant to explaining gendered earnings (Bettio & Verashchagina 2009). According to our own analyses based on German microdata, occupational position accounts for 3.4 percentage points of the German gender wage gap (Boll & Leppin 2015). Unfortunately in the SIAB, information on an individual's hierarchical position is only available for full-time workers because part-time work is categorized as one of the occupational positions. This makes it impossible to trace vertical segregation and their earnings consequences for part-time workers.

Descriptive Statistics

Table A1 in the Annex reports descriptive sample statistics for cohorts 1950-64. Men earn over their career on average 891,803 euros, whereas women's lifetime

earnings amount to 451,802 euros. Women make up 45.0% of all employees in our sample, and cohorts 1959-61 are most frequent among both genders. Only 3.3% of women and 5.3% of men report a non-German nationality. With 25.3 years on average, men exhibit more years of employment than women do (21.8 years). Whereas women have been working 5.5 (1.0) years in large (low) scale part-time jobs at the end of their career, men lack significant observations in reduced work hours. While observed OLF spans are unsurprisingly short for both genders, amounting to a few months only, with 7.5 years, women's non-observed breaks ('blind spells') are twice as high as men's (3.7 years). By contrast, men spend more time in registered unemployment than women (1.7 vs. 1.4 years).[11] Men are also more qualified on average, accounting for both a higher share of employees with tertiary education (14.1% vs. 8.1%) and a lower share of the low-skilled (4.8% vs. 6.2%) than women do.

Regarding occupations, we observe the traditional gender segregation, with women's share on employees being highest in medical, social and care occupations. The gendered segregation of occupations is by no means restricted to the cohorts under observation in our study, but rather is a persistent phenomenon. To date, women account for at least 70% of employees in social, health, education, cleaning and nursing professions (Hausmann & Kleinert 2014). A similar pattern is observed for other European countries (Bettio & Verashchagina 2009) and the US (Hegewisch et al. 2010). Occupational change is deemed to be less likely the more specific acquired qualifications are. For example, industrial occupations are more qualification-specific than administrative and service occupations (Seibert 2007).

Occupations are differently distributed across sectors (Warnken 1986). Relating to technological progress, some occupations that require highly specified skills are clustered in a few sectors only, whereas others cover a broad range of sectors (Buchmann & Sacchi 1995). Furthermore, more flexible working schemes have resulted in a higher occupational diversity at the workplace (Spöttl & Blings 2011: 19). In our sample, the majority of workers in an occupational segment is distributed across 2-3 main sectors. For example, employees in merchandise occupations concentrate in the trade sector and in the banking and insurance sector. Only a few occupations, among them teaching professions, are concentrated in one single sector with more than 50% of employees. Furthermore, occupational rewards vary across sectors and within sectors by gender. Additional analyses show that particularly among white collar workers but also in merchandise occupations, the within-occupation gender pay gap differs markedly between sectors. On the other hand, for female teachers, a public administration sector affiliation relates to lower earnings than an education sector affiliation. In our analyses of the GLEG, we therefore control for both occupational segments and sectors.

Results

Lifetime earnings regressions

Because the coefficients of the OLS lifetime earnings regressions provide the basis for the calculation of the adjusted GLEG in the next chapter, we briefly sketch the most interesting findings. Table A2 in the Annex reports the full results. For women, one year of employment (full-time or part-time) experience yields an earnings premium of 7.2%. When this year relates to low (large)-scale part-time experience, the premium decreases by 3.9 (1.3) percentage points. For men, the overall experience premium is 6.0%, which diminishes by 7.0 (2.6) percentage points in the case of low (large)-scale part-time experience. That is, men achieve higher earnings penalties for part-time (compared to full-time) experience. In this context, it is important to note that the occupational position as the vertical dimension of occupational segregation is not directly measurable with the data at hand. Since leadership positions are most frequently assumed in full-time jobs (Holst et al. 2015)[12], we suggest that the higher part-time penalties (that is, higher full-time premiums) of men could principally relate to their higher positioning in the firm's hierarchy.[13] A previous year out-of-the-labor force (OLF) is associated with an earnings penalty amounting to 4.0% (6.8%) for men (women). As mentioned, OLF spells last a few months only, and the job contract is maintained during that time, whereas unobserved breaks are many times longer. Blind spells cause a wage penalty of 2.3% (men) and 2.9% (women) per year. In case of registered unemployment, the penalty is higher for men (4.7%) than for women (3.8%). A higher formal education is more highly rewarded for men than for women, compared to the benchmark education (completed vocational training). Moreover, a non-German nationality is negatively related to men's earnings, but not to women's. Furthermore, men and women differ in occupational and sector returns.

Magnitude of the unadjusted gender lifetime earnings gap

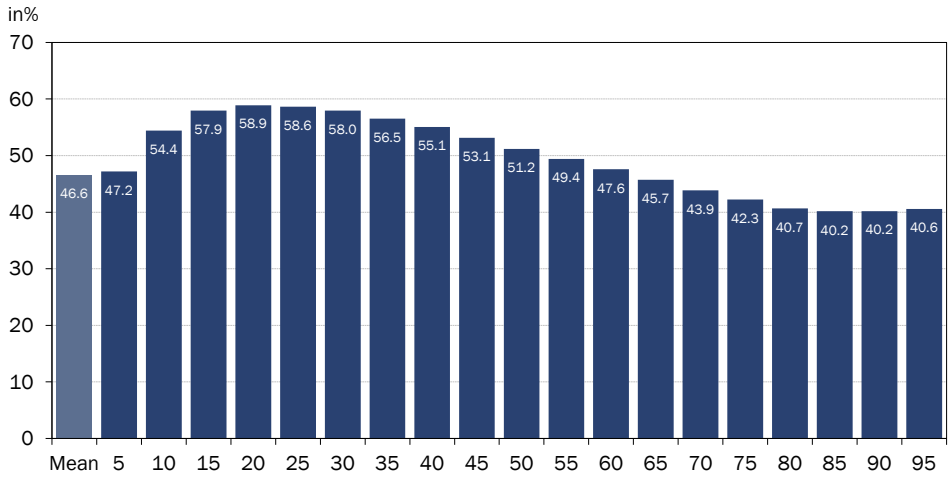
In this chapter, we present results on the calculated and decomposed mean gender lifetime earnings gap (GLEG).

First, Figure 1 shows the distribution of the mean gap by earnings quantiles. The bar "mean" depicts the average gap over the whole distribution. Note that, as indicated in Section 3, the end of the career is marked by the last available observation of the individual. Women earn on average 46.6% less income during their employment career than men do. Apparently, women do not manage to close that part of the gap resulting from family-related breaks and reduced work hours at older ages. This points to generally flatter earnings profiles of women compared to men, which confirms previous findings by Aretz (2013, p. 26) based on the SIAB 1975-2008 for West Germany. He reports an overall lower earnings mobility of

women throughout the observation period, although he finds a slight convergence process between genders.

However, the gender gap in lifetime earnings notably differs across the earnings distribution. As Figure 1 shows, the gap decreases between the 20% and the 85% quantile and slightly increases at the top of the distribution.

Figure 1
Unadjusted gender lifetime earnings gap, by 5 quantiles



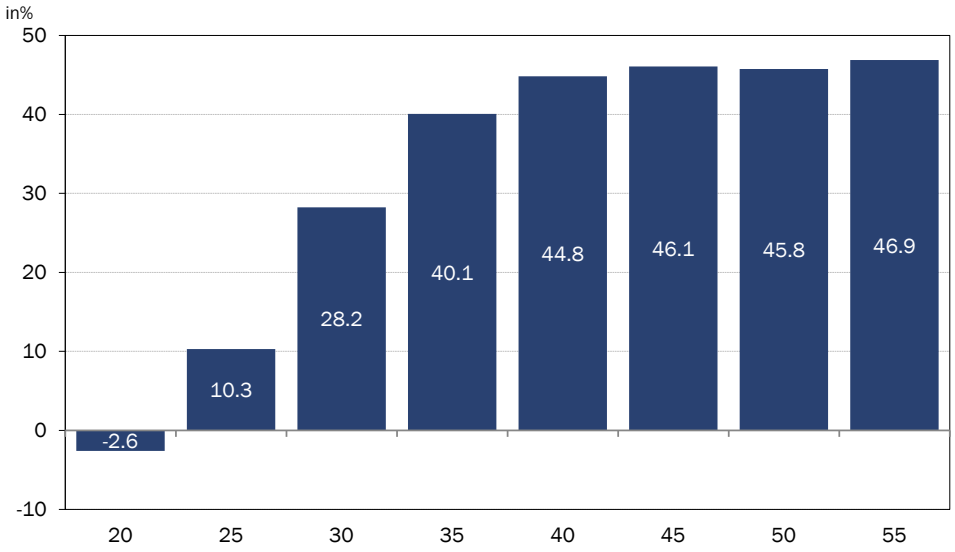
Sources: Sample of Integrated Labour Market Biographies—SIAB 7510 SUF; HWWI.

Contrary to results of quantile statistics for the gender pay gap that often come up with higher gaps at the upper end of the earnings distribution than in the middle (e.g., Boll & Leppin 2015 for Germany; OECD 2012 for Europe), our results do not confirm such a pattern for the GLEG. In contrast, the GLEG is below average in the highest third of the distribution and peaks at the 20% quantile. Additional decomposition analyses show that in the top 20% of the earnings distribution, the share of the explained part on the overall gap is far below its respective share in the lowest 20%. Although the share of the unexplained gap is almost the same both at the top and the bottom of the distribution, endowments of men and women, particularly those relating to employment experience, are much more similar at the top. For example, in the lowest 20% of the earnings distribution, women's fewer years in employment make up for 23.3 log-points of the explained gap (36.2 log-points). Among the highest 20% earners, this factor does not significantly add to the gap. Furthermore, part-time work hardly impacts the earnings gap at the top (2.7 log-points), while it contributes with 14.4 log-points at the bottom of the distribution.

In comparison with the gender pay gap, we conclude that employment biography is much more important for the GLEG than for the hourly pay gap, triggering the decreasing overall GLEG over the earnings distribution. Note, however, that although the raw gender gap is purely descriptive, the decomposition results rely on the model fit, which has been optimized for the mean gap and which differs between different groups along the earnings distribution and also within these groups between men and women. Therefore, although the higher similarity of employment careers at the top is plausible since it might be a prerequisite for both genders to achieve top earnings positions, the detailed decomposition figures have to be interpreted with some caution.

Figure 2 depicts the evolution of the mean gender earnings gap over the life course. Specifically, the gender difference in accumulated earnings upon respective age is calculated, based on the age-specific cross-sections in the data. As indicated, the gap increases up to age 45 and then stagnates. The earnings differential particularly widens between age 25 and 35, that is, in the period of family formation[14]. The finding that the pay gap particularly widens when women's family responsibility increases is also supported by analyses focusing on hourly wage differentials (Goldin et al. 2017).

Figure 2
Mean unadjusted gender earnings gap, by age



Sources: Sample of Integrated Labor Market Biographies—SIAB 7510 SUF; HWWI.

Numbers resemble remarkably the composition of the gender pension gap by

age. For West Germans of the cohort group 1946-55 (1956-65), the gender gap with respect to statutory pensions starts with 22% (20%) at age 25 and increases to roughly 50% (45%) at age 55 (and a further slight increase occurs up to age 65; Grabka et al. 2017)[15]. Due to the strong connection between old-age pension entitlements and the individual employment career in the German statutory pension system, the similarity of results is not that astonishing on second examination, despite substantial differences in methodology and data.

However, our GLEG approach goes one step further because we not only measure the overall (unadjusted) gap over the life course, but also trace the evolution of its main drivers. In what follows, we address the role of gender differences in endowments and remunerations for the overall mean gender earnings gap.

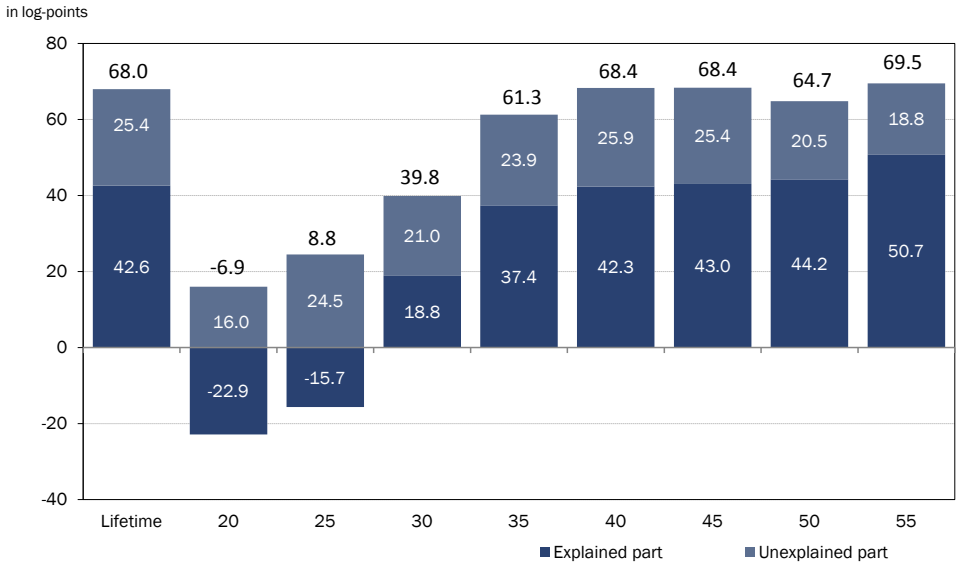
Decomposing the unadjusted gap into an explained and an unexplained part

We first focus on the overall mean gap of 46.6%. The approximation of relative differences (percentages) by log differences (as used in the decomposition) becomes inaccurate for larger relative differences. For example, the mean gap of 46.6% is equivalent to 68.0 log points (the mean gap is denoted "Lifetime" in Figure 3). We will use the concept of log points in the following discussion[16]. The so-called explained gap denotes the part of the overall gap that is due to different endowments of women and men in terms of individual and workplace related characteristics. The unexplained part of the gap (the so-called adjusted gap) is comprised of (a) the remuneration effects, referring to different rewards for women and men for the same characteristic, and (b) a residuum (in technical terms, the 'constant') that remains completely unexplained (for more methodological details, see Section 3). The log point-based analysis provides valuable insights regarding the relative importance of the explained and the unexplained part of the gap and the role of single factors driving the results. Table A3 in the Annex reports detailed decomposition results.

As Figure 3 shows, almost two-thirds (42.6 log points) of the overall gap can be explained with different endowments of women and men in earnings-relevant characteristics, whereas more than a third refers to the unexplained part (adjusted earnings gap, 25.4 log points).

Note that the adjusted gap is positive throughout the age distribution, that is, women accumulate fewer earnings than men do, even if one compares men and women with similar observed characteristics. By contrast, endowments are to the advantage of women at age 20 and 25. At age 20, the explained part of the gap outweighs the unexplained one, that is, women's accumulated earnings at age 20 are higher than that of 20-year-old men. Young women's endowment advantage reverses at age 30, when 18.8 out of 39.8 log points relate to less favorable characteristics of women compared to men. From then on, women accumulate fewer

Figure 3
Decomposition of the mean unadjusted gender earnings gap, by age



Sources: Sample of Integrated Labour Market Biographies—SIAB 7510 SUF; HWWI.

earnings than men do, due to both less advantageous endowments and a residuum that fails to be explained with the characteristics at hand. Note that the explained part of the gap significantly increases from age 25 to age 35, presumably related to diverging employment patterns of women and men in the course of family formation. Note also that observation numbers for people aged 50 to 55 are far lower than for younger people in our sample. For example, there are 71,397 (31,686) observations from people aged 30 (50).

Decomposing the explained and the unexplained gap in its single factors

In this section, we analyze the role of single factors within the explained and unexplained part of the reported earnings gaps. We thereby partly aggregate single characteristics to groups, e.g., the 21 occupational segments to the group "occupation" and the 14 sector affiliations to the group "sector". Furthermore, unemployment spells, blind spells and OLF spells form the group "years of non-employment", whereas the group "work hours" is comprised of low-scale and large-scale part-time (with full-time as a reference). With both decompositions illustrated in Figure 4, we start with the same unadjusted gap of 68.0 log-points. The bar on the left-hand side of Figure 4 focuses on the decomposition of the explained part, and the bar on the right-hand side of Figure 4 on the unexplained part. The group contri-

butions sum up to the 42.6 log points of the explained gap and the 25.4 log points of the unexplained gap, respectively, as noted in Figure 3. Some minor factors are pooled to residuum groups (cf. Table A3 in the Annex for the full decomposition results). Hereafter, we discuss some interesting findings.

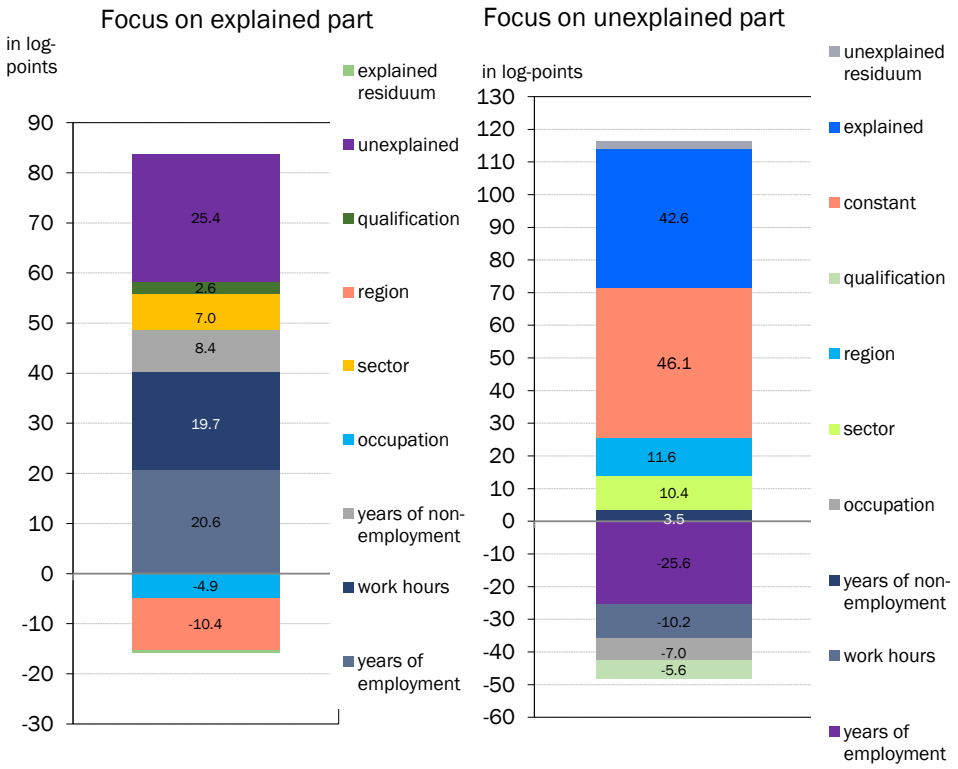
As the bar on the left-hand side of Figure 4 illustrates, the explained part of the gap is dominated by the different labor market participation of women and men. Men's shorter spells of non-employment contribute with 8.4 log-points and men's longer spells of employment with 20.6 log-points to the gap[17]. Additionally, men less seldom work part-time, which makes up for a further 19.7 log-points. In sum, gender differences in the named three factors of labor market attachment and hours account for roughly 72% of the overall gap (48.7 out of 68.0 log points). The occupational distribution is associated with an earnings advantage of women. Women work more frequently in pay-attractive occupations than men, accounting for 4.9 log points of the overall earnings gap. Note that occupation is potentially correlated with sector (for more details, see Boll et al. 2017). Sectoral segregation contributes with 7.0 log-points to the gap[18]. Furthermore, men in our sample exhibit higher average education than women do, which contributes with 2.8 log points to the earnings gap. Region clearly works in favor of women, i.e., women concentrate less in less densely populated areas with lower wages. The remaining factors are of minor relevance.

The bar on the right-hand side of Figure 4 illustrates the relative importance of single factors to the unexplained (adjusted) gap. Here, the constant is the clearly dominant component with 46.1 log points. The diagram shows that most evaluation effects are to the advantage of women, with region, sector and years of non-employment marking the exceptions. For example, women receive higher earnings premiums for years of employment and suffer lower part-time penalties (compared to full-time) than men, decreasing the overall gap by 25.6 and 10.2 log-points, respectively. Women also receive higher earnings premiums than men for the same occupation and formal qualification. On the other hand, as can also be learned from Table A 2, women suffer higher wage penalties for living in less densely populated areas as well as for unobserved ('blind spells') and observed (OLF) years of non-employment. Moreover, women not only work more often in less pay-attractive sectors, but they also benefit less from sector affiliation than men do. Goldin et al. (2017), who also report men-benefiting sectoral endowments and premiums based on Longitudinal Employer-Household Dynamics (LEHD) and census data, motivate these findings with gender mobility differentials both between and within sectors and firms.

Next, we present results on the earnings gap decomposition by age (see Figure 5). These analyses show how the importance of single factors evolves over the life course. Table A 4 in the Annex reports the full results.

Presumably due to men's military service spells in early years of the career,

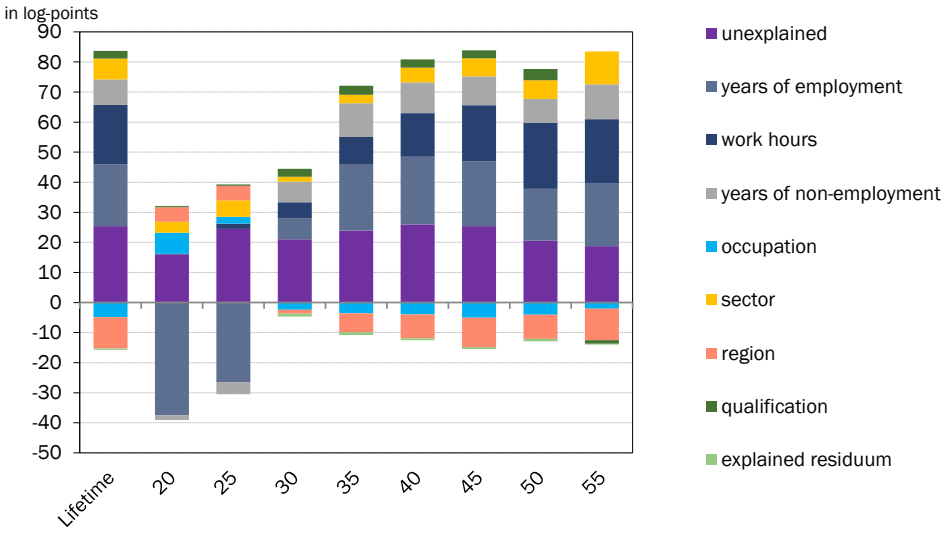
Figure 4
Decomposition of the mean gender lifetime earnings gap (68.0 log-points)—with a focus on the explained part (42.6 log-points) and the unexplained part (25.4 log-points)



Sources: Sample of Integrated Labour Market Biographies– SIAB 7510 SUF; HWWI.

women exhibit a higher (lower) number of years of (non)-employment at early ages, which reduces the gender gap in accumulated earnings at age 20 and 25. The trend reverses at age 30. From then on, years of employment and years of non-employment contribute to the gender gap in accumulated earnings. The contribution of years of non-employment peaks first at age 35 (11.2 log-points) and decreases thereafter, with another peak at age 55 (11.8 log-points). Similarly, years of employment peak at age 40 (22.5 log-points) and are the most relevant driver of the explained gap up to age 45. From age 50 onwards, working hours hold this position. At age 50, women's higher prevalence in part-time jobs peaks with 22.0 log-points of the overall gap and barely decreases thereafter. This finding supports the finding of a high part-time persistence of (West) German women over the life course, which is well-known from the literature. In Germany, 58.3% of working women with a youngest child at teen age (12+) holds a part-time job, whereas the

Figure 5
Decomposition of the explained part of the of the gender earnings gap, by age



Sources: Sample of Integrated Labour Market Biographies—SIAB 7510 SUF; HWWI.

EU-28 average is 32.1% (Eurostat 2015). In general, women seem to connect to the labor market a bit more between age 45 and 50 with respect to years, but this does not hold for the intensive margin in terms of hours, and thereafter, they seem to lose contact again.

The sectoral distribution of women and men adds to the pay gap at any age. As mentioned, Goldin et al. (2017) suggest that men have greater preferences or abilities than women to move to higher paying firms and positions and that this factor particularly increases with women's increasing family responsibilities. Also, Barth et al. (2017) with US-LEHD data highlight the importance of differential mobility of women and men between establishments for the increasing overall gap over the lifecycle, particularly for those who are married. This points to the Mincerian thesis that in traditional gender role settings, married women behave like 'tied movers' and 'tied stayers' (Mincer 1978), particularly in the presence of young children in the household. Efficiency gains via intra-household specialization further enforce the resulting gender wage differential (Becker 1981). The occupational composition of genders decreases the earnings gap from age 30 onwards.

Comparing the Gender Earnings Gap across cohorts

Up until now, our results have referred to the cohorts 1950-64. From the literature, we know that gender differences in characteristics related to human capital have

been continuously decreasing (Goldin 2014, Blau & Kahn forthcoming), whereas the occupational and sectoral segregation of genders (Blau & Kahn forthcoming) as well as working time remain important. Goldin (2014) examines this result with compensation differential theory, stating that firms could penalize employees for deviating from the full-time-full-year (FTFY) standard employment pattern, to pass on firms' costs of time-flexibility to their employees. Since women bear the lion's share of household tasks, they are in general more in need of flexible work hours. We want to know if the outlined changing patterns across generations are supported by our German data. To this end, we extend our analyses to cohorts 1970-1979 and 1980-89. Summary statistics of the younger cohort groups[19] indeed support the notion of a decreasing role of human capital, i.e., women and men become more similar in terms of employment experience and education, with a share of tertiary education among women exceeding men's in the youngest cohort group 1980-89. However, we are interested in analyzing the drivers of the gender earnings gap by age. Since the data cover the period 1975-2010 only, cohorts 1980-89 (1970-79) are observable until age 30 (40) the longest. Therefore, we focus on age 25, 30 and 35.[20]

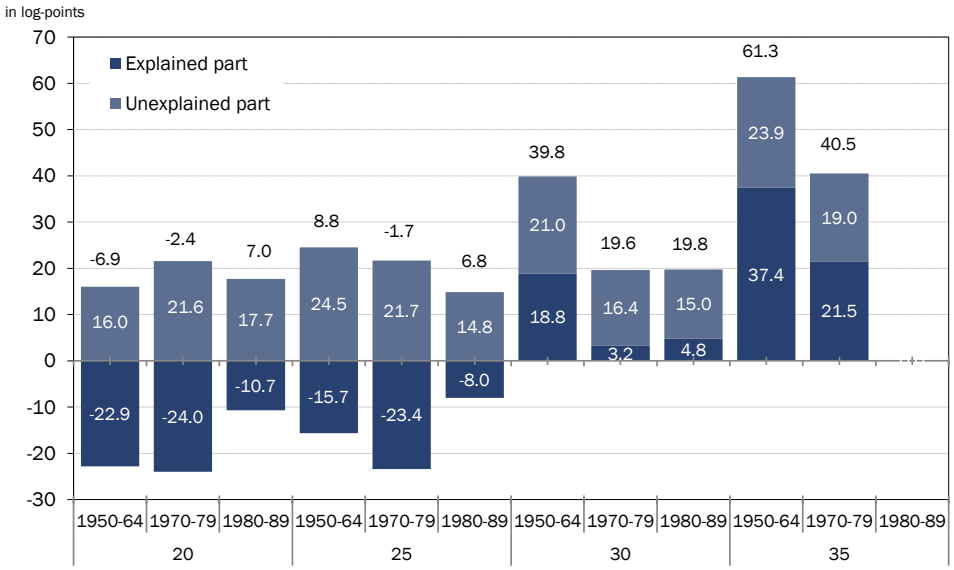
As Figure 6 illustrates, the gap composition by age in younger cohorts resembles that of older ones, with an increasing unadjusted earnings gap with age. Note that also in younger cohorts, endowments work to the advantage of women at the very beginning of their careers, turning to disadvantages at age 30, whereas the unexplained residuum (adjusted earnings gap) is to women's disadvantage at any age.

In this respect, the results for younger cohorts fully replicate those of cohort 1950-64. However, the age pattern of the younger cohorts shows up on an overall lower level of the gap.

Further interesting insights can be derived from decomposing the explained gap (see Figure 7 and Table A5 in the Annex) and the unexplained gap (see Figure 8 and Table A 6 in the Annex) into its single factors. First, what stands out in Figure 8 is the prominent role of the constant, named the "gender effect" in equation 3 (see Section 2 encompassing the truly unexplained part of the earnings gap. Two findings regarding the constant are worth noting. First, up to age 30, the constant is generally less advantageous for younger generations than for the cohort group 1950-64. Second, between age 30 and 35, the contribution of the constant to the earnings gap notably increases, triggering the increase of the unexplained gap (see Figure 6). As discussed in Section 2 , the constant constitutes one part of the unexplained gap, and evaluation effects constitute the second part. The latter refer to gender-different wage returns to the same endowment. Next, we discuss endowment and remuneration effects for selected characteristics, both across ages and cohorts.

When comparing ages within cohorts, years of employment turn into a disad-

Figure 6
Decomposition of the mean unadjusted gender earnings gap in an explained and an unexplained part, by cohorts and age

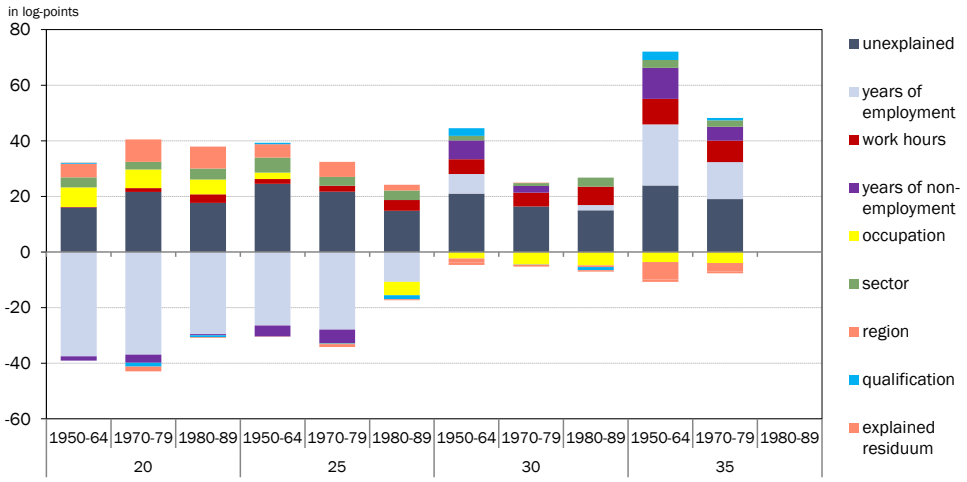


Sources: Sample of Integrated Labour Market Biographies—SIAB 7510 SUF; HWWI. Note: Persons of cohorts 1980-89 are not observed at age 35.

vantage for women at age 30 in all three cohort groups, with a further deterioration up to age 35 (shown for cohorts 1950-64 and 1970-79 in Figure 7). Comparing cohorts at distinct ages, however, reveals that even in the period of family formation between age 25 and 35, gender employment differences lose importance in younger cohorts. Our result is in accordance with findings from Westermeier et al. (2017), who also show that "housewife" spells decrease from 10.6 years (cohort group 1946-55) to 7.1 years (cohort group 1956-65) and 5.2 years (1966-70). For employment premiums (Figure 8), women of all cohorts suffer lower premiums than men do in their early years, but the picture reverses at age 35. Moreover, gender differences in employment premiums are smaller in younger generations. Because employment premiums mirror genders' wage mobility over the career, i.e., through training on the job and job promotions, we suggest that women's chances improve both over the life course and across generations.

Women's educational drawback in cohorts 1950-64 disappears in younger generations. This means that women's lower endowments no longer contribute to the gender earnings gap. The study of Westermeier et al. (2017) supports our finding of a closing gender education gap across cohorts, reporting a gap amounting to 1.2 years in the cohort group 1946-55 and to only 0.6 years in the cohort group 1966-70. However, an educational lead of women over men as is the case for female

Figure 7
Decomposition of the mean gender earnings gap in its single factors with a focus on the explained gap, by cohorts and age



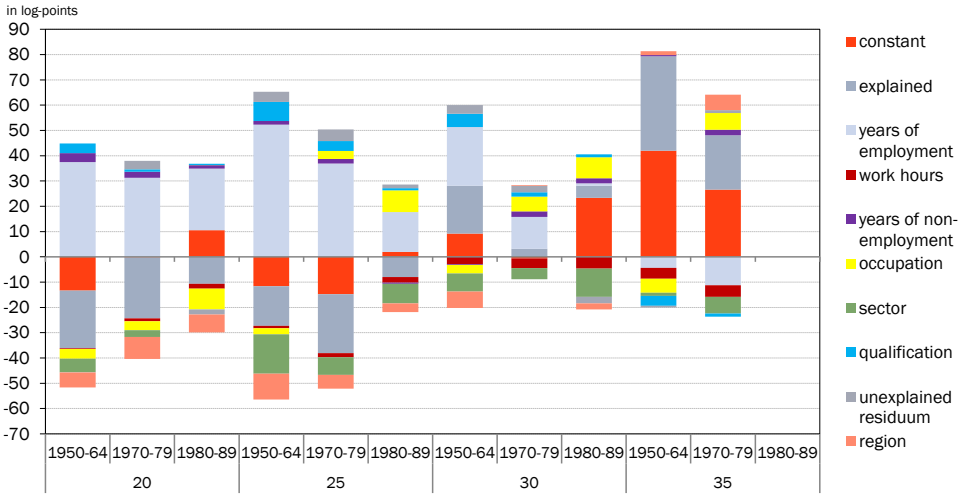
Sources: Sample of Integrated Labour Market Biographies—SIAB 7510 v1; HWWI. Note: Persons of cohorts 1980-89 are not observed at age 35.

workers in most European countries (Boll et al. 2016) cannot be ascertained with our data. Still, women's education premiums approach men's in younger generations. All in all, our findings indicate that human capital differentials lose importance for the gender earnings divide across generations. This fits into a decreasing importance over time as has been highlighted by various studies (e.g., Blau and Kahn 2016 for the US).

By contrast, women's higher part-time frequency (factor "work hours") is to their detriment at any age, with an increasing importance with age. But contrary to the effect of employment breaks, part-time does not lose importance in younger cohorts. Also, this finding is supported by the study of Westermeier et al. (2017), who report an even slightly increasing average number of part-time years from cohorts group 1946-55 to cohort group 1966-70. With respect to part-time penalties, the finding that women suffer lower penalties than men remains constant across cohorts. This might relate to a still higher societal acceptance of part-time work for women compared to men or to the fact that part-time penalties are lower in the public sector, where women prevail (BMFSFJ 2009, p. 13). Third, Goldin's (2014) thesis of compensation differentials also makes sense: if costs of time-inflexibility do relate to both technology and culture, firms might pay genders different premiums for sticking to the traditional full-time-full-year (FTFY) employment pattern, depending on firm-specific gender roles, time and leadership culture. However, we cannot rule out that the gendered penalty is driven by differences between men and

women in weekly hours within part-time jobs (cf. Section 4.1).

Figure 8
Decomposition of the mean gender earnings gap in its single factors with a focus on the unexplained gap, by cohorts and age



Sources: Sample of Integrated Labour Market Biographies— SIAB 7510 SUF; HWWI. Note: Persons of cohorts 1980-89 are not observed at age 35.

What about segregation? Whereas sector premiums were to the advantage of women up to age 30 in the cohort group 1950-64 and vanished at age 35, the effect seems to gain size and to last during family formation in younger generations. However, as we learned from the decomposition of the mean GLEG (for cohorts 1950-64, cf. Figure 4), sector premiums are to women's disadvantage from the life course perspective. More favorable sector premiums for men than for women are also reported for most European countries based on data of the Structure of Earnings Survey 2010 (Boll et al. 2016). For our data, this means that women of cohorts 1950-64 will lose their within-sector wage mobility advantage at older ages past 35, although the turning point of age is somewhat moved for younger generations. All in all, while women continue to work in less pay-attractive sectors, females in younger generations benefit more than those in older generations from within-sector mobility. Occupational segregation mostly decreases the earnings gap across generations. At the same time, occupational premiums turn into a disadvantage in younger cohorts.

Conclusion

Taking the challenges of the gender pay gap to monitor the gender earnings divide over the life course as a starting point, this study introduced a new indicator for gender earnings inequality. The gender lifetime earnings gap (GLEG) measures the difference in men's and women's accumulated earnings over at least 30 years of their careers, with male earnings as a benchmark. To this end, we use information from 72,085 German individuals of the SIAB 1975-2010 SUF, focusing on cohorts born 1950-64, but additionally exploring cohorts 1970-79 (1980-89) up to the age of 30 (35).

For cohorts 1950-64, the GLEG amounts to 46.6%, meaning that men accumulate more than twice as much earnings as women over their career. The gender earnings gap is above average between the 5%- and the 60%-quantile of the earnings distribution and below average in the highest third. The gender earnings gap is remarkably similar to the gender pension gap by age. Almost two-thirds of the overall gap refer to different endowments of women and men in earnings-relevant characteristics, whereas more than a third refers to the unexplained part. Women's lower labor market attachment in terms of years of employment and working hours are the most prominent single endowments. Comparing the GLEG across age groups reveals that women's labor market attachment particularly worsens during the period of family formation (age 25-35). The unexplained part of the gap is driven by the constant throughout age groups, but different remunerations of genders for the same characteristics also play a role. It cannot be ruled out that the constant contains statistically unobserved pay-relevant factors like further endowments, gendered preferences and (dis-)abilities, which might interact with gendered returns to observed characteristics. Therefore, the unexplained lifetime earnings differential must not be equated with gender discrimination in lifetime earnings. Analyses for younger cohort groups show that both the explained and the unexplained gap somewhat decrease across cohorts. Gender differences in human capital endowments like employment experience and formal education diminish, whereas females' higher frequency in part-time work continues to mark a significant portion of the explained gap, at least during the period of family formation. Still, women benefit from lower part-time penalties across cohorts. Moreover, women in younger cohorts approach men with respect to employment, education and sector premiums.

The question of whether these favorable trends will continue over later career stages of the cohorts 1970-89 so that they manage to close the gender gap in lifetime earnings has to be left to future research, based on longer observation periods. Specifically, it remains open whether women's continued part-time employment at older ages continues to magnify the gap. Preferences of men (women) for a down (up-) scaling of current work schedules give rise to the expectation of more

gender-egalitarian work patterns in the near future. For example, in 2015, 12.1% of German female part-timers aged 15-64 wished to work more hours (Eurostat 2017), whereas from 1991 to 2013, actual weekly work hours of fathers of children below the age of 16 in the household were well above the individually desired work hours (Holst & Wieber 2014). Women and men born 1980-96 report a strong preference for dual part-time earner-arrangements on the household level (BMFSFJ 2015)[21]. In this context, a valuable research topic will be to explore how the increasing female leadership positioning (Kohaut & Möller 2016) fits into these patterns. Bearing the correlation between sectors and occupations in mind, another open question left to future research is whether the currently highly debated revaluation of social professions in Germany will materialize in a narrowing gender earnings gap in the future. Finally, controlling for unobserved heterogeneity by exploiting the panel structure of the data seems a valuable addition to this study. In future work with earnings simulation techniques that build on panel estimates, we aim to quantify lifetime earnings depending on biographical and occupational decisions and gender.

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Appendix

Table A1. Summary Statistics

	Men		Women	
Employment biography	Mean	SD	Mean	SD
Years in employment	25.278	6.398	21.835	7.077
Years in low-scale part-time employment	0.078	0.618	1.014	2.882
Years in large-scale part-time employment	0.337	1.607	5.462	6.580
Years out-of-the-labour force (OLF)	0.061	0.197	0.261	0.401
Years of unemployment	1.689	2.949	1.428	2.117
Blind spells	3.656	4.296	7.460	6.002
Occupation				
„Green“ occupations	0.475	2.979	0.170	1.567
Miner/chemical occupations	1.829	5.588	0.439	2.723
Glass, ceramic, paper production	0.437	2.919	0.198	1.760
Textile, leather production	0.374	2.408	0.487	2.563
Metal producer	5.176	9.233	0.403	2.465
Electricians	2.536	6.791	0.549	2.901
Wood occupations	0.654	3.525	0.060	0.939
Constructing	2.090	6.037	0.255	2.168
Hotel/restaurant occupations	0.869	3.856	1.583	4.658
Storage/ transport occupations	3.101	6.844	0.840	3.158
White collar worker	1.877	5.894	4.044	7.638
Merchandise occupations	2.269	6.275	6.557	9.790
Security occupations	0.850	3.456	0.158	1.396
Social/care occupations	0.289	2.383	1.497	5.288
Medical occupations	0.267	2.332	2.876	7.257
Physicians	0.093	1.456	0.097	1.347
Teaching professions	0.158	1.699	0.223	2.058
Artists/Athletes	0.096	1.337	0.082	1.147
Natural scientists	0.193	1.926	0.068	1.049
Humanists	0.056	1.109	0.079	1.243
Unskilled worker	0.285	1.867	0.117	1.137
Not specified	0.038	0.483	0.029	0.417
Sector				
Agriculture, energy, mining	0.692	3.749	0.114	1.254
Prod. of rubber/plastic products, process. minerals, wood ind.	0.770	3.671	0.273	2.014
Chemical industry	0.717	3.829	0.308	2.342

Table A1. Summary Statistics

	Men		Women	
Metal production and processing, mechanical engineering	3.514	7.950	0.811	3.598
Automotive, data process. equip., electrical/optical engineering	3.098	7.610	1.115	4.256
Consumer goods	2.115	6.040	1.761	4.917
Hospitality industry	0.259	1.949	0.470	2.359
Building industry	2.550	6.454	0.365	2.202
Sale, maintenance/repair of motor vehicles/household goods	3.220	7.007	3.841	7.125
Transport and communication	1.392	4.741	0.584	2.935
Credit and insurance intermediation; Land and hosing, rentals	2.278	5.987	2.893	6.704
Public and personal services, households services	0.996	4.307	1.101	3.908
Education, social and health-care facilities	1.039	4.340	5.172	8.806
Public administration, social security	1.171	4.750	1.772	5.710
Not specified	0.064	0.875	0.025	0.355
Type of Region				
Central city in urban areas	7.173	10.389	6.194	9.541
Highly agglomerated county in agglomeration areas	4.836	8.947	3.686	7.594
Agglomerated county in agglomeration areas	1.483	5.307	1.277	4.729
Rural county in agglomeration areas	0.271	2.253	0.275	2.189
Central city in urbanized areas	1.612	5.538	1.533	5.185
Agglomerated county in urbanized areas	4.711	9.322	4.147	8.276
Rural county in urbanized areas	1.888	6.277	1.616	5.467
Rural county with higher density in rural areas	1.740	6.117	1.704	5.791
Rural county with lower density in rural areas	0.556	3.515	0.496	3.148
Not specified	0.042	0.428	0.044	0.436
Qualification				
No completed vocational training	0.048	0.270	0.062	0.304
Vocational training	0.761	0.427	0.786	0.410
High school degree (‚Abitur‘)& vocational training	0.050	0.218	0.071	0.256
University of Applied Sciences	0.065	0.246	0.035	0.185
University	0.076	0.266	0.046	0.209
Not specified	0.001	0.027	0.001	0.030
Cohort				
1950	0.008	0.087	0.002	0.045
1951	0.008	0.089	0.003	0.057
1952	0.009	0.093	0.003	0.057
1953	0.007	0.082	0.004	0.063
1954	0.035	0.184	0.013	0.113

Table A1. Summary Statistics

	Men		Women	
1955	0.027	0.163	0.018	0.132
1956	0.015	0.123	0.021	0.145
1957	0.028	0.165	0.038	0.191
1958	0.050	0.219	0.067	0.250
1959	0.140	0.347	0.146	0.353
1960	0.139	0.346	0.147	0.355
1961	0.142	0.349	0.145	0.352
1962	0.139	0.346	0.142	0.349
1963	0.138	0.345	0.141	0.348
1964	0.114	0.318	0.109	0.312
German nationality	0.916	0.277	0.948	0.222
Non-German nationality	0.053	0.225	0.033	0.179
Nationality not specified	0.030	0.171	0.019	0.136
Number of employers	6.804	5.493	6.156	4.119
Observations No.	39629		32456	

Sources: Sample of Integrated Labour Market Biographies – SIAB 7510 SUF; HWWI.

Table A2. Lifetime Earnings Regression Results (OLS)

	Men		Women	
	Coefficient	SE	Coefficient	SE
Employment biography				
Years in employment	0.06***	0.002	0.072***	0.003
Years in low-scale part-time employment	-0.07***	0.002	-0.039***	0.001
Years in large-scale part-time employment	-0.026***	0.001	-0.013***	0.000
Years out-of-the-labour force (OLF)	-0.04***	0.006	-0.068***	0.004
Years of unemployment	-0.047***	0.001	-0.038***	0.001
Blind spells	-0.023***	0.001	-0.029***	0.001
Occupation				
„Green“ occupations	-0.006***	0.002	-0.002	0.002
Miner/chemical occupations	0.000	0.002	0.005**	0.002
Glass, ceramic, paper production	-0.002	0.002	0.004*	0.002
Textile, leather production	0.001	0.002	-0.001	0.002
Metal producer	-0.003*	0.002	0.000	0.002
Electricians	0.002	0.002	0.005**	0.002
Wood occupations	-0.006***	0.002	0.003	0.003
Constructing	-0.001	0.002	0.007***	0.002
Hotel/restaurant occupations	-0.007***	0.002	-0.002	0.002
Storage/ transport occupations	-0.005***	0.002	0.001	0.002
White collar worker	0.003*	0.002	0.003	0.002
Merchandise occupations	0.004***	0.002	0.006***	0.002
Security occupations	0.002	0.002	0.004*	0.002

Table A2. Lifetime Earnings Regression Results (OLS)

	Men		Women	
Social/care occupations	-0.002	0.002	0.012***	0.002
Medical occupations	0.002	0.002	0.005**	0.002
Physicians	0.019***	0.002	0.025***	0.002
Teaching professions	0.001	0.002	0.009***	0.002
Artists/Athletes	-0.001	0.002	0.01***	0.002
Natural scientists	0.007***	0.002	0.017***	0.003
Humanists	0.009***	0.002	0.015***	0.002
Unskilled worker	-0.007***	0.002	0.004	0.003
Not specified	-0.004	0.003	-0.01**	0.004
Sector				
Agriculture, energy, mining	0.012***	0.002	0.001	0.002
Prod. of rubber/plastic products, process. minerals, wood industry	0.012***	0.002	0.006***	0.002
Chemical industry	0.017***	0.002	0.016***	0.002
Metal production/processing, mechanical engineering	0.015***	0.002	0.012***	0.002
Automotive, data processing equipment, electrical/optical engineering	0.018***	0.002	0.014***	0.002
Consumer goods	0.013***	0.002	0.004**	0.002
Hospitality industry	0.004**	0.002	-0.003	0.002
Building industry	0.011***	0.002	-0.001	0.002
Sale, maintenance and repair of motor vehicles and household goods	0.009***	0.002	0.002	0.002
Transport and communication	0.012***	0.002	0.011***	0.002
Credit and insurance intermediation; Land and hosing, rentals	0.015***	0.002	0.011***	0.002
Public and personal services, households services	0.015***	0.002	0.001	0.002

Table A2. Lifetime Earnings Regression Results (OLS)

	Men		Women	
Education, social and health-care facilities	0.01***	0.002	0.008***	0.002
Public administration, social security	0.009***	0.002	0.008***	0.002
Not specified	0.007***	0.002	-0.014***	0.005
Type of Region				
Central city in urban areas	-0.03***	0.002	-0.034***	0.003
Highly agglomerated county in agglomeration areas	-0.03***	0.002	-0.037***	0.003
Agglomerated county in agglomeration areas	-0.033***	0.002	-0.039***	0.003
Rural county in agglomeration areas	-0.033***	0.002	-0.04***	0.003
Central city in urbanized areas	-0.031***	0.002	-0.036***	0.003
Agglomerated county in urbanized areas	-0.032***	0.002	-0.039***	0.003
Rural county in urbanized areas	-0.033***	0.002	-0.04***	0.003
Rural county with higher density in rural areas	-0.033***	0.002	-0.039***	0.003
Rural county with lower density in rural areas	-0.034***	0.002	-0.041***	0.003
Not specified	-0.001	0.003	0.001	0.004
Qualification (Ref.: vocational training)				
No completed vocational training	-0.121***	0.006	-0.058***	0.007
High school degree (‚Abitur‘)& vocational training	0.13***	0.006	0.099***	0.006
University of Applied Sciences	0.39***	0.005	0.185***	0.009
University	0.498***	0.006	0.357***	0.009
Not specified	-0.043	0.044	-0.181***	0.050

Table A2. Lifetime Earnings Regression Results (OLS)

	Men		Women	
Cohort (Ref.: 1959)				
1950	-0.001	0.014	-0.011	0.035
1951	-0.019	0.014	0.033	0.028
1952	-0.02	0.014	0.03	0.027
1953	0.000	0.015	0.001	0.025
1954	-0.01	0.007	0.06***	0.014
1955	0.008	0.008	0.043***	0.012
1956	0.017*	0.010	0.031***	0.011
1957	0.029***	0.008	0.048***	0.009
1958	0.021***	0.006	0.024***	0.007
1960	-0.003	0.004	0.000	0.006
1961	-0.003	0.005	-0.027***	0.006
1962	-0.009*	0.005	-0.036***	0.006
1963	-0.021***	0.005	-0.064***	0.007
1964	-0.022***	0.006	-0.072***	0.007
Nationality (Ref: German)				
Non-German nationality	-0.023***	0.005	0.011	0.009
Nationality not specified	-0.039***	0.007	-0.031***	0.011
Number of employers	-0.004***	0.000	-0.002***	0.000
Constant	12.808***	0.025	12.396***	0.030

Table A2. Lifetime Earnings Regression Results (OLS)

	Men	Women
F-statistic	2558.010	1927.510
Prob>F	0.000	0.000
Adj. R^2 and R^2	0.831	0.819
Root MSE	0.232	0.269

Sources: Sample of Integrated Labour Market Biographies – SIAB 7510 SUF; HWWI.

Table A3. Oaxaca-Blinder Decomposition of the gender lifetime earnings gap

	Coefficient	SE
Total		
Men	13.701***	(0.003)
Women	13.021***	(0.004)
Difference	0.68***	(0.005)
Explained	0.426***	(0.006)
Unexplained	0.254***	(0.005)
Explained part		
Employment biography		
Years in employment	0.206***	(0.009)
Years in low-scale part-time employment	0.065***	(0.002)
Years in large-scale part-time employment	0.132***	(0.004)
Years out-of-the-labour force (OLF)	0.008***	(0.001)
Years of unemployment	-0.012***	(0.001)
Blind spells	0.088***	(0.003)
Occupation		
„Green“ occupations	-0.002***	(0.001)
Miner/chemical occupations	0.000	(0.002)
Glass, ceramic, paper production	-0.001	(0.000)
Textile, leather production	0.000	(0.000)
Metal producer	-0.014*	(0.007)
Electricians	0.004	(0.003)
Wood occupations	-0.003***	(0.001)
Constructing	-0.002	(0.003)
Hotel/restaurant occupations	0.005***	(0.001)
Storage/ transport occupations	-0.011***	(0.004)
White collar worker	-0.007*	(0.003)
Merchandise occupations	-0.018***	(0.007)
Security occupations	0.001	(0.001)
Social/care occupations	0.003	(0.002)
Medical occupations	-0.004	(0.004)
Physicians	0.000	(0.000)
Teaching professions	0.000	(0.000)
Artists/Athletes	0.000	(0.000)
Natural scientists	0.001***	(0.000)
Humanists	0.000**	(0.000)
Unskilled worker	-0.001***	(0.000)

Table A3. Oaxaca-Blinder Decomposition of the gender lifetime earnings gap

	Coefficient	SE
Not specified	0.000	(0.000)
Sector		
Agriculture, energy, mining	0.007***	(0.001)
Prod. rubber/plastic products, processing minerals, wood ind.	0.006***	(0.001)
Chemical industry	0.007***	(0.001)
Metal production and processing, mechanical engineering	0.041***	(0.004)
Automotive, data process. equipment, electr./optical engineering	0.036***	(0.003)
Consumer goods	0.004***	(0.001)
Hospitality industry	-0.001**	(0.000)
Building industry	0.023***	(0.003)
Sale, maintenance/repair of motor vehicles/household goods	-0.006***	(0.001)
Transport and communication	0.01***	(0.001)
Credit and insurance intermediation; Land and hosing, rentals	-0.009***	(0.001)
Public and personal services, households services	-0.002***	(0.000)
Education, social and health-care facilities	-0.042***	(0.007)
Public administration, social security	-0.005***	(0.001)
Not specified	0.000***	(0.000)
Type of Region		
Central city in urban areas	-0.029***	(0.003)
Highly agglomerated county in agglomeration areas	-0.035***	(0.003)
Agglomerated county in agglomeration areas	-0.007***	(0.001)
Rural county in agglomeration areas	0.000	(0.001)
Central city in urbanized areas	-0.002*	(0.001)
Agglomerated county in urbanized areas	-0.018***	(0.002)
Rural county in urbanized areas	-0.009***	(0.002)
Rural county with higher density in rural areas	-0.001	(0.001)
Rural county with lower density in rural areas	-0.002**	(0.001)
Not specified	0.000	(0.000)
Qualification		
No completed vocational training	0.003***	(0.000)
Vocational training	0.003***	(0.000)
High school degree (‚Abitur‘)& vocational training	0.000	(0.000)
University of Applied Sciences	0.007***	(0.000)
University	0.011***	(0.001)
Not specified	0.000	(0.000)
Cohort		

Table A3. Oaxaca-Blinder Decomposition of the gender lifetime earnings gap

	Coefficient	SE
1950	0.000	(0.000)
1951	0.000	(0.000)
1952	0.000	(0.000)
1953	0.000	(0.000)
1954	0.000	(0.000)
1955	0.000	(0.000)
1956	0.000*	(0.000)
1957	0.000***	(0.000)
1958	0.000***	(0.000)
1959	0.000	(0.000)
1960	0.000	(0.000)
1961	0.000	(0.000)
1962	0.000	(0.000)
1963	0.000	(0.000)
1964	0.000*	(0.000)
German nationality	-0.001***	(0.000)
Non-German nationality	0.000	(0.000)
Nationality not specified	0.000***	(0.000)
Number of employers	-0.003***	(0.000)
Unexplained part		
Employment biography		
Years in employment	-0.256***	(0.088)
Years in low-scale part-time employment	-0.031***	(0.002)
Years in large-scale part-time employment	-0.071***	(0.004)
Years out-of-the-labour force (OLF)	0.007***	(0.002)
Years of unemployment	-0.013***	(0.002)
Blind spells	0.041***	(0.009)
Occupation		
„Green“ occupations	-0.001	(0.000)
Miner/chemical occupations	-0.002*	(0.001)
Glass, ceramic, paper production	-0.001**	(0.001)
Textile, leather production	0.001	(0.001)
Metal producer	-0.001	(0.001)
Electricians	-0.002	(0.001)
Wood occupations	-0.001***	(0.000)
Constructing	-0.002***	(0.001)

Table A3. Oaxaca-Blinder Decomposition of the gender lifetime earnings gap

	Coefficient	SE
Hotel/restaurant occupations	-0.008*	(0.004)
Storage/ transport occupations	-0.005**	(0.002)
White collar worker	-0.001	(0.011)
Merchandise occupations	-0.012	(0.017)
Security occupations	0.000	(0.000)
Social/care occupations	-0.021***	(0.004)
Medical occupations	-0.01	(0.008)
Physicians	-0.001**	(0.000)
Teaching professions	-0.002***	(0.001)
Artists/Athletes	-0.001***	(0.000)
Natural scientists	-0.001***	(0.000)
Humanists	0.000*	(0.000)
Unskilled worker	-0.001***	(0.000)
Not specified	0.000	(0.000)
Sector		
Agriculture, energy, mining	0.001***	(0.000)
Production rubber/plastic products, processing minerals, wood	0.002**	(0.001)
Chemical industry	0.000	(0.001)
Metal production and processing, mechanical engineering	0.003	(0.002)
Automotive, data process. equipment, electr./optical engineering	0.005*	(0.003)
Consumer goods	0.015***	(0.004)
Hospitality industry	0.003***	(0.001)
Building industry	0.004***	(0.001)
Sale, maintenance/repair of motor vehicles/household goods	0.028***	(0.009)
Transport and communication	0.001	(0.001)
Credit and insurance intermediation; Land and hosing, rentals	0.011	(0.007)
Public and personal services, households services	0.015***	(0.003)
Education, social and health-care facilities	0.013	(0.013)
Public administration, social security	0.002	(0.004)
Not specified	0.001***	(0.000)
Type of Region		
Central city in urban areas	0.025	(0.021)
Highly agglomerated county in agglomeration areas	0.022*	(0.013)
Agglomerated county in agglomeration areas	0.007*	(0.004)
Rural county in agglomeration areas	0.002**	(0.001)
Central city in urbanized areas	0.007	(0.005)

Table A3. Oaxaca-Blinder Decomposition of the gender lifetime earnings gap

	Coefficient	SE
Agglomerated county in urbanized areas	0.026*	(0.014)
Rural county in urbanized areas	0.012**	(0.006)
Rural county with higher density in rural areas	0.01*	(0.006)
Rural county with lower density in rural areas	0.004**	(0.002)
Not specified	0.000	(0.000)
Qualification		
No completed vocational training	-0.007***	(0.001)
Vocational training	-0.054***	(0.009)
High school degree (‚Abitur') & vocational training	-0.003***	(0.001)
University of Applied Sciences	0.005***	(0.000)
University	0.003***	(0.001)
Not specified	0.000	(0.000)
Cohort		
1950	0.000	(0.000)
1951	0.000	(0.000)
1952	0.000	(0.000)
1953	0.000	(0.000)
1954	-0.001***	(0.000)
1955	-0.001**	(0.000)
1956	0.000	(0.000)
1957	0.000	(0.000)
1958	0.000	(0.001)
1959	0.001	(0.001)
1960	0.000	(0.001)
1961	0.004***	(0.001)
1962	0.005***	(0.001)
1963	0.007***	(0.001)
1964	0.006***	(0.001)
German nationality	0.013**	(0.005)
Non-German nationality	-0.001**	(0.000)
Nationality not specified	0.000	(0.000)
Number of employers	-0.013***	(0.003)
Constant	0.461***	(0.039)

Sources: Sample of Integrated Labour Market Biographies – SIAB 7510 SUF; HWWI. Total number of observation is 72085 (39629 for men, and 32456 for women).

Table A4. Decomposition of the explained part of the of the mean gender earnings gap, by age

		Contribution to the gap at age ... (in log points)							
	Lifetime	20	25	30	35	40	45	50	55
Unexplained	25.36	15.99	24.51	21.00	23.90	25.92	25.35	20.54	18.77
Years employment	20.65	-37.55	-26.50	7.04	21.95	22.50	21.63	17.23	20.74
Work hours	19.71	0.19	1.75	5.29	9.19	14.56	18.59	22.03	21.46
Years non-employment	8.43	-1.49	-3.89	6.82	11.19	10.15	9.64	7.94	11.55
Occupation	-4.88	7.05	2.28	-2.37	-3.61	-3.93	-5.04	-4.02	-2.05
Sector	7.00	3.59	5.45	1.63	2.83	4.93	6.02	6.20	11.00
Region	-10.37	4.89	4.78	-1.30	-6.30	-7.95	-9.75	-8.10	-10.48
Qualification	2.55	0.37	0.47	2.71	3.01	2.74	2.60	3.74	-1.22
Explained residuum	-0.47	0.09	-0.01	-0.98	-0.86	-0.66	-0.66	-0.78	-0.28
Total observations	72,085	51,096	68,622	71,397	71,878	72,015	72,051	31,686	4,713
Men	39,629	27,111	37,263	39,248	39,536	39,597	39,613	17,530	3,414
Women	32,456	23,985	31,359	32,149	32,342	32,418	32,438	14,156	1,299

The explained residuum contains the following factors: Cohorts, nationality, and number of employers. Sources: SIAB 7510 SUF; HWWI.

Table A5. Decomposition of the mean gender earnings gap in its single factors with a focus on the explained gap, by cohorts and age

	Contribution to the gap at age ... (in log points)										
	20			25			30			35	
	1950 -1964	1970 -1979	1980 -1989	1950 -1964	1970 -1979	1980 -1989	1950 -1964	1970 -1979	1980 -1989	1950 -1964	1970 -1979
Unexplained	15.99	21.57	17.68	24.51	21.67	14.82	21.00	16.38	14.97	23.90	19.01
Years employment	-37.55	-36.89	-29.51	-26.50	-27.90	-10.78	7.04	-0.12	1.92	21.95	13.36
Work hours	0.19	1.42	3.05	1.75	2.19	3.85	5.29	4.97	6.64	9.19	7.68
Years non-empl.	-1.49	-2.98	-0.49	-3.89	-5.00	0.01	6.82	2.41	-0.12	11.19	4.96
Occupation	7.05	6.67	5.37	2.28	-0.12	-4.78	-2.37	-4.35	-4.70	-3.61	-3.97
Sector	3.59	2.77	3.92	5.45	3.15	3.46	1.63	1.02	3.26	2.83	2.36
Region	4.89	8.05	7.91	4.78	5.41	2.01	-1.30	0.13	-0.63	-6.30	-3.10
Qualification	0.37	-1.36	-0.63	0.47	-0.14	-1.47	2.71	-0.12	-1.09	3.01	0.83
Explained residuum	0.09	-1.66	-0.31	-0.01	-0.99	-0.32	-0.98	-0.71	-0.50	-0.86	-0.60
Total observations	51,096	46,605	31,539	68,622	100,336	55,986	71,397	103,357	9,635	71,878	61,170
Men	27,111	25,588	17,493	37,263	53,451	29,260	39,248	55,094	5,202	39,536	32,701
Women	23,985	21,017	14,046	31,359	46,885	26,726	32,149	48,263	4,433	32,342	28,469

Sources: SIAB 7510 SUF; HWWI. Note: Persons of cohorts 1980-89 are not observed at age 35.

Table A6. Decomposition of the mean gender earnings gap in its single factors with a focus on the unexplained gap, by cohorts and age

	Contribution to the gap at age ... (in log points)										
	20			25			30			35	
	1950 -1964	1970 -1979	1980 -1989	1950 -1964	1970 -1979	1980 -1989	1950 -1964	1970 -1979	1980 -1989	1950 -1964	1970 -1979
Explained	-22.85	-24.00	-10.70	-15.66	-23.40	-8.02	18.84	3.23	4.78	37.40	21.51
Years employment	37.44	31.25	24.37	52.26	36.92	15.79	23.22	12.54	0.91	-4.39	-11.26
Work hours	-0.32	-1.15	-1.83	-0.95	-1.55	-2.13	-2.93	-3.79	-4.68	-4.22	-4.56
Years non-empl.	3.60	2.37	1.30	1.48	1.77	-0.51	-0.25	2.25	2.00	0.47	2.19
Occupation	-3.82	-3.57	-8.23	-2.40	3.18	8.55	-3.40	5.77	8.32	-5.56	6.65
Sector	-5.30	-2.68	0.07	-15.59	-6.96	-7.72	-7.14	-4.38	-11.19	-1.30	-6.56
Region	-5.92	-8.67	-7.04	-10.27	-5.51	-3.45	-6.51	0.33	-2.37	1.50	6.18
Qualification	3.75	0.97	0.56	7.55	3.88	0.90	5.33	1.71	1.14	-3.90	-1.26
Constant	-13.30	-0.29	10.56	-11.58	-14.73	1.93	9.23	-0.64	23.37	41.95	26.56
Unexpl. residuum	-0.15	3.34	-2.06	4.02	4.66	1.45	3.44	2.59	-2.54	-0.65	1.07
Total observations	51,096	46,605	31,539	68,622	100,336	55,986	71,397	103,357	9,635	71,878	61,170
Men	27,111	25,588	17,493	37,263	53,451	29,260	39,248	55,094	5,202	39,536	32,701
Women	23,985	21,017	14,046	31,359	46,885	26,726	32,149	48,263	4,433	32,342	28,469

Sources: SIAB 7510 SUF; HWWI. Note: Persons of cohorts 1980-89 are not observed at age 35.

Table A7. Analysis of sample residuals

Sample residuals	Without new restrictions		With new restrictions	
	Men	Women	Men	Women
Standard deviation	0.33666	0.45605	0.23194	0.26943
Skewness	-2.4596	-2.3949	-0.3334	-0.3904
Kurtosis	26.65	18.6	5	4.16
N	41391	39205	39629	32456

Sources: SIAB 7510 SUF; HWWI.

Table A8. Exclusion criteria and respective observation losses

	Men	Women	Total
Individuals SIAB SUF total	851728	742738	1594466
Individuals SIAB SUF cohorts 1950-64	226483	208137	434620
Individuals (cohorts 1950-64) affected by exclusion criteria			
Employed before 1st of January, 1975	723	650	1373
Entry to the labour market later than age 30	67693	66441	134134
Less than 30 years of observability	140588	125848	266436
Maximum age depending on attained education			
Age 24 (compl. vocat. training and high school grad.)	1514	1366	2880
Age 21 (Abitur but without vocational training)	2493	1289	3782
Age 21 (without Abitur and compl. vocat. training)	46480	36962	83442
Age 18 (lacking both of latter named qualifications)	33972	31769	65741
Less than 5 years of employment	63496	63196	126692
More than 20 years of "blind spells"	4184	17360	21544
Sample size with restrictions	39629	32456	72085

Sources: SIAB 7510 SUF; HWWI.

Notes

[1]Moreover, the use of instruments leads to a higher variance, hence the IV estimation is justified only if its advantage outweighs the disadvantage.

[2]The 30-years-time frame is set due to data restrictions and serves as an approximation of lifetime earnings. See more details on average employment duration in the sample description below. Furthermore, the 30-years-span serves as a lower bound which individual careers are allowed to extend (but not to fall short of). The calculation takes account of this heterogeneity by controlling for years in employment and years of non-employment separately.

[3]This notion describes a post-discriminatory market as Blau & Kahn (forthcoming: 6) point out. Building on the assumption that females' characteristics are remunerated like males', this adjustment of the overall gap relegates the remaining gender gap to gendered rewards.

[4]In more detail, we used the Scientific Use File of the data. Only information with less than 20 observations (individuals and/or plants) will not be reported (Hochfellner et al. 2012). For a detailed data documentation, cf. vom Berge et al. (2013).

[5]By moving to the new federal states later in life, some people became part of the sample.

[6]We thereby account for different earnings ceilings between years and within years between German regions.

[7]We further tested an imputation that uses gender-specific earnings predictions, the results were essentially the same.

[8]Specifically, there are three types of areas (agglomeration, urbanized and rural areas). Within agglomeration areas, central cities (>100.000 inhabitants) are distinguished from highly agglomerated counties (population density>300 inhabitants/km2), agglomerated counties (population density>150 inhabitants/km2) and rural coun-

ties (population density<150 inhabitants/km2). Within urbanized areas, central cities and agglomerated counties of the same type as in agglomeration areas apply. In rural areas, rural counties with a population density >100 inhabitants/km2 are distinguished from those with a population density <100 inhabitants/km2.

[9]For the differentiation between small/large part-time and full-time, we use the occupational position variable („Stellung im Beruf") that is available in the data. The 18 hours-boundary was introduced in 1988. From 1975 to 1978, the threshold for small-scale part-time was 20 hours and from 1979 to 1987 it was 15 hours. It cannot be ruled out that the recoding procedures has biased gendered part-time "endowments" and relatedly, gendered earnings. As weekly work hours are not observable, the extent of such a potential bias may not be assessed.

[10]Deleting spells of marginal employment would have caused a large drop in the observation numbers, disproportionately affecting women.

[11]Note that as the data span the period 1975-2010, individual employment careers will probably lack observation in their late years before retirement, as this is the more likely the later individuals are born. Westermeier et al. (2017) report with data from the Socio-Economic Panel (SOEP) and the "Versicherungskontenstichprobe" of the German Pension Insurance System (FDZ-RV) that West German women's employment experience (years in full- or part-time work) adds to 30.6 years (cohorts 1946-55) and 32.1 years (cohorts 1956-65), respectively. However, "housewife spells" last 10.6 years (cohorts 1946-55) and 7.1 years (cohorts 1956-65) on average, which is close to our findings. This is plausible since family breaks occur at stages in life that are well met by our data. Compared to the study of Westermeier et al. (2017), underestimation of employment spells in our data is most likely for part-time spells.

[12]In 2013, only 20% of women and 2% of men in leadership positions in the private sector report actual work hours below 35 hours per week.

[13]However, as we do not measure metric weekly working hours, we are not able to quantify per-hour-penalties of part-time work but only differences in daily wages. Thus, it remains unclear if lower daily wages accruing from part-time work (compared to full-time work) result from lower hourly earnings and/or lower hours.

[14]Reported values for age 20 to 55 differ from the lifetime earnings gap of 46.6% since the latter refers to accumulated earnings at the time of the last observation. Note that the age distribution reflects cross-sections of our sample at the corresponding age (referring to different cohorts each) and must not be confused with a life course analysis of a given cohort. Therefore, older (younger) generations are relatively more frequent in older (younger) age groups.

[15]In the definition of the gender pension gap used by Grabka et al. (2017), pension entitlements refer to average individual own old-age pension entitlements only.

[16]The main argument against the use of percentages is that, in contrast to log-points, they are not consistent with the summation of single components of the gap.

[17]Note that, although, as aforementioned, years of non-employment comprise of (registered) unemployment spells, spells out-of-the-labor force and 'blind spells' without an observed work contract, the latter clearly dominate the group effect of non-employment spells.

[18]Sector affiliation increases the gender earnings gap as sector premiums, denoted as wage premiums for one year of employment experience in the respective sector, are lower for women than for men throughout sectors. This holds true for each of the 14 sectors, even for those where women display a higher experience than men do (education, social and health care facilities, credit and insurance intermediation, sales etc.). Concerning sector, disadvantageous evaluations add to disadvantageous endowments, as women are underrepresented in sectors with relatively higher experience premiums (for both genders), e.g. chemical industry. By contrast, women earn higher occupation premiums, denoted as wage premiums for one year of employment experience in the respective occupation. This applies to all 21 occupational segments. Furthermore, women dominate in some of the comparatively premium-attractive occupations such as humanists or social/care occupations. Per saldo, occupational segregation decreases the gender earnings gap.

[19]Summary statistics on cohort groups 1970-79 and 1980-89 are available from the authors upon request.

[20]Wage estimation and detailed decomposition results extending those in Tables A 5 and A 6 in the Annex are available from the authors upon request. Note for the findings as discussed in what follows relating to changing patterns of gendered endowments across cohort groups that age-specific signs of wage returns are essentially the same for both genders across cohorts.

[21]Basis: Online Survey on behalf of the Federal Ministry of Family Affairs, Senior Citizens, Women and Youth (BMFSFJ) in September/October 2014 among 4,166 women and men born from 1980 to 1996 („Generation Y"-Check).